



U.S. Army Research, Development and Engineering Command

The logo for the Army Research Laboratory (ARL). It features the letters "ARL" in a large, bold, black sans-serif font. The top of the "A" and "R" are highlighted with yellow triangular shapes. The background of the slide is a dark red gradient with a faint world map and binary code (0s and 1s) overlaid.

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Collaborative Development of a Mine Detection Training Device

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Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE OCT 2012		2. REPORT TYPE		3. DATES COVERED 00-00-2012 to 00-00-2012	
4. TITLE AND SUBTITLE Collaborative Development of a Mine Detection Training Device				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Research, Development and Engineering Command,US Army Research Laboratory,2800 Powder Mill Road,Adelphi,MD,20783-1197				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the 2012 Science, Technology & Requirements Forum held 17-18 October in Fort Leonard Wood, MO.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 15	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

- The Challenge
- Finding the Right Skills to develop the Training Device
- Collaborative Partners
 - Army Research Laboratory
 - Academia
 - Industry
- Funding Source
 - Leonard Wood Institute
 - Awarded on a Competitive Basis
- The Training Device
- Transitioning to the Army

- AN/PSS-14 uses two sensors:
 - Induction coil (metal detector)
 - Ground Penetrating Radar (change in di-electric constant detector)
- Can only detect what it passes over – every square inch of the lane must be swept with the detector head close to the ground
- Employs internal algorithms that must be trained to soil similar to that to be searched
- Requires relatively frequent recalibration



U.S. Army Combat Engineer with PSS-14 near Bagram Airport, Afghanistan, April 2004

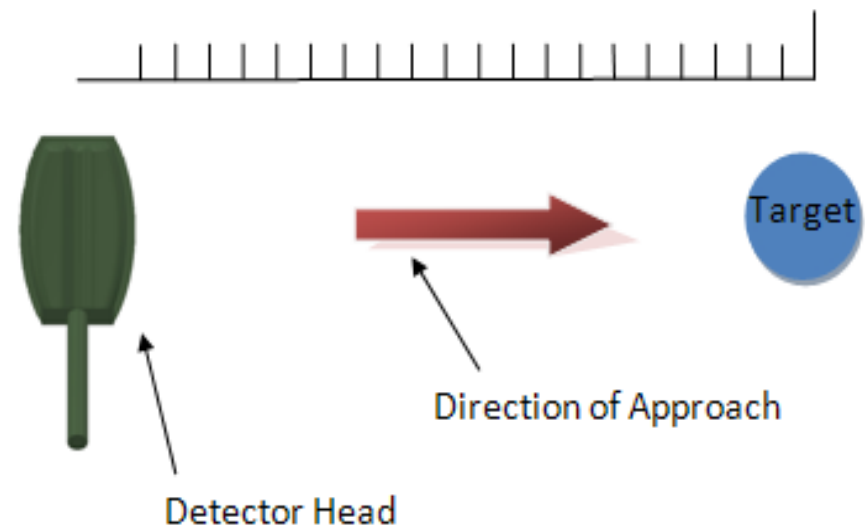
- AN/PSS-14 Training
 - Learn detector switchology – start up, algorithm training, maintaining calibration
 - Learn to sweep – covering every square inch of the lane at the right sweep speed and with the detector height the right distance above the ground
 - Target investigation – with the metal detector and the Ground Penetrating Radar
 - How to convert the auditory information from the detector to a spatial image of the target in the ground, primarily based on the location of the detector head when the sound is emitted.
 - And to do so with such proficiency that they are willing to bet their life and others on their performance capability
- Studies have shown that the skill degradation of AN/PSS-14 operators significantly decline in as little as 30 days
- Development of good training lanes are very labor intensive and require expensive simulants
- Training is dependent on weather conditions
- Regular training is logistically prohibitive for many units – particularly Reserve Component units
- A simulator can address many of these training issues

- Develop a highly realistic Landmine Detection Simulator that closely resembles the form, function, and responses of the AN/PSS-14 built around an easy to assemble, operate, and low-cost platform.
- Required Team Skill Set:
 - Programming capability
 - Understanding of how the detector works
 - Understanding of what detector features are key to effective training
 - Understanding of how the detector is swept and output is interpreted
 - Ability to write the equations to define the appropriate auditory output for a variety of target types
 - Understanding of the human factors issues such that fidelity is appropriate
 - Ability to fabricate the prototype hardware
 - Knowledge of how to apply the most cost effective technology

- Industry
 - Advanced Military Equipment, Inc.
 - Advancia
- Academia
 - Missouri University of Science and Technology
 - Lincoln University
- Government
 - U.S. Army Research Laboratory

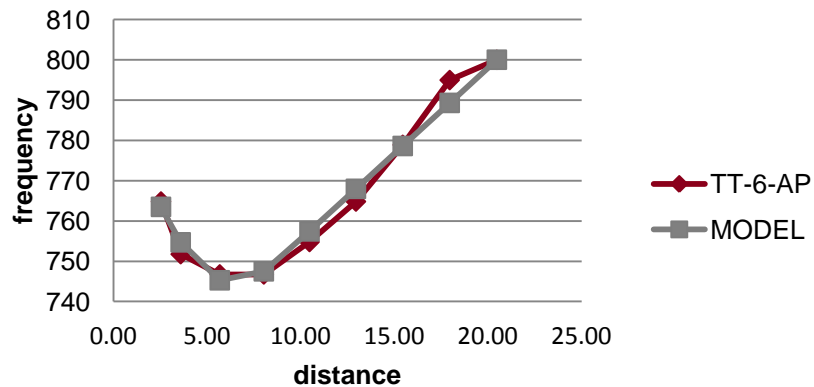
- Missouri S&T Submitted a proposal based on a Leonard Wood Institute solicitation
 - Leonard Wood Institute funded via a Congressional ad coming through the U.S. Army Research Laboratory
 - Proposal selected on a competitive basis
 - Technical Reviewers
 - Operational Reviewers
 - Academic Reviewers
 - LWI and ARL Reviewers

- Utilizing buried clutter, simulants, and defused mines
- Frequency and amplitude readings were taken at incremental distances to the target
- Data was then plotted accounting for target depth and total distance

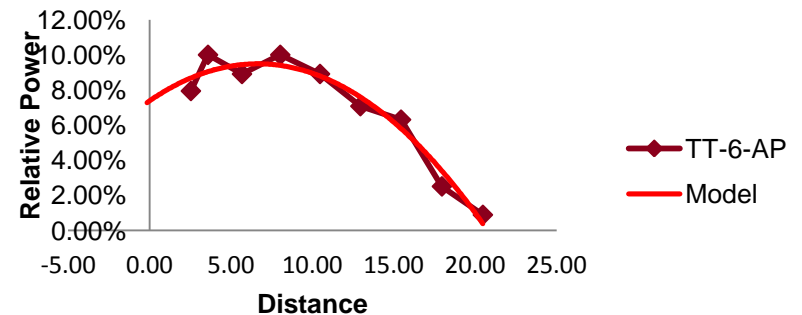


- Polynomial regression method of analysis

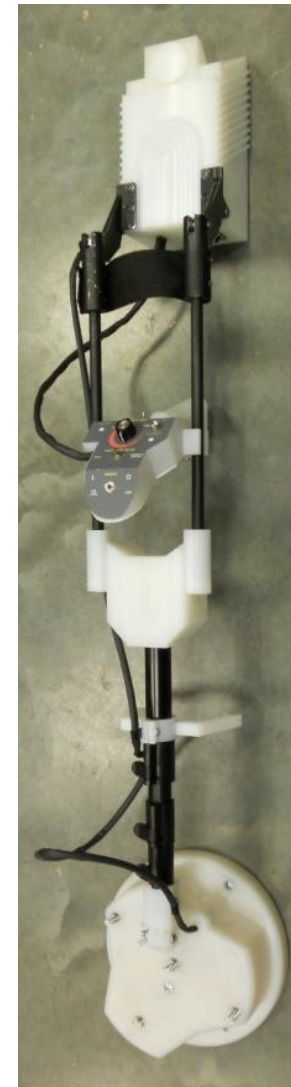
TT-6-AP Frequency Modeling

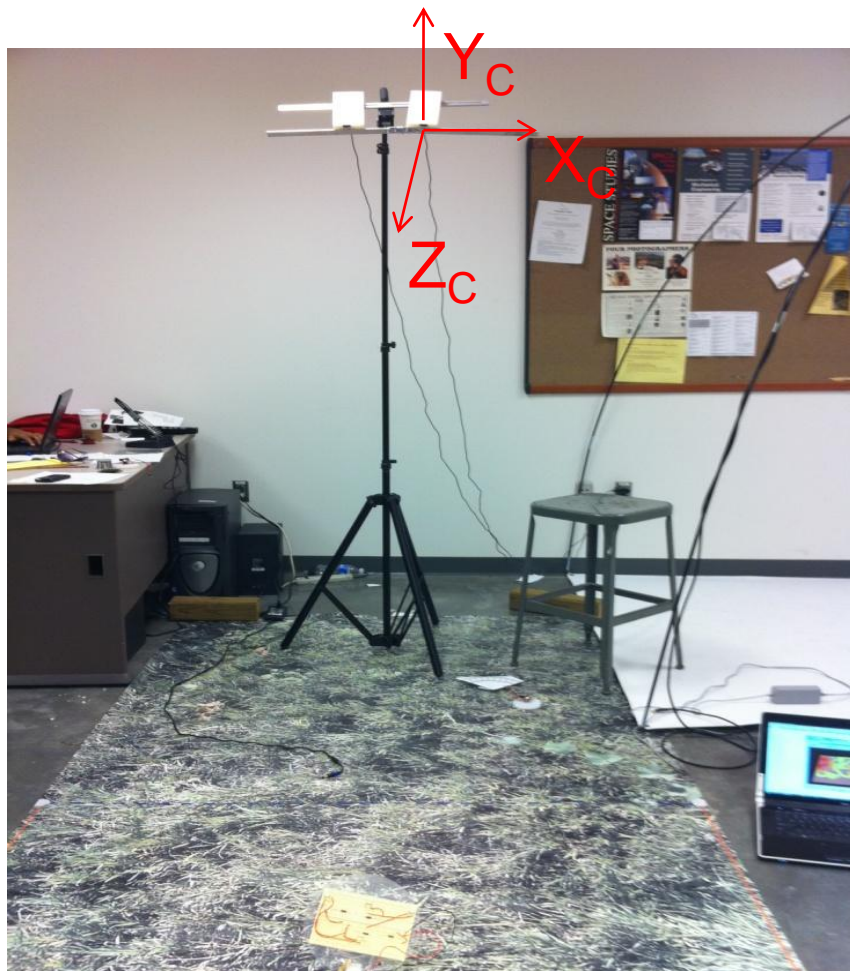


TT-6-AP Amplitude Modeling

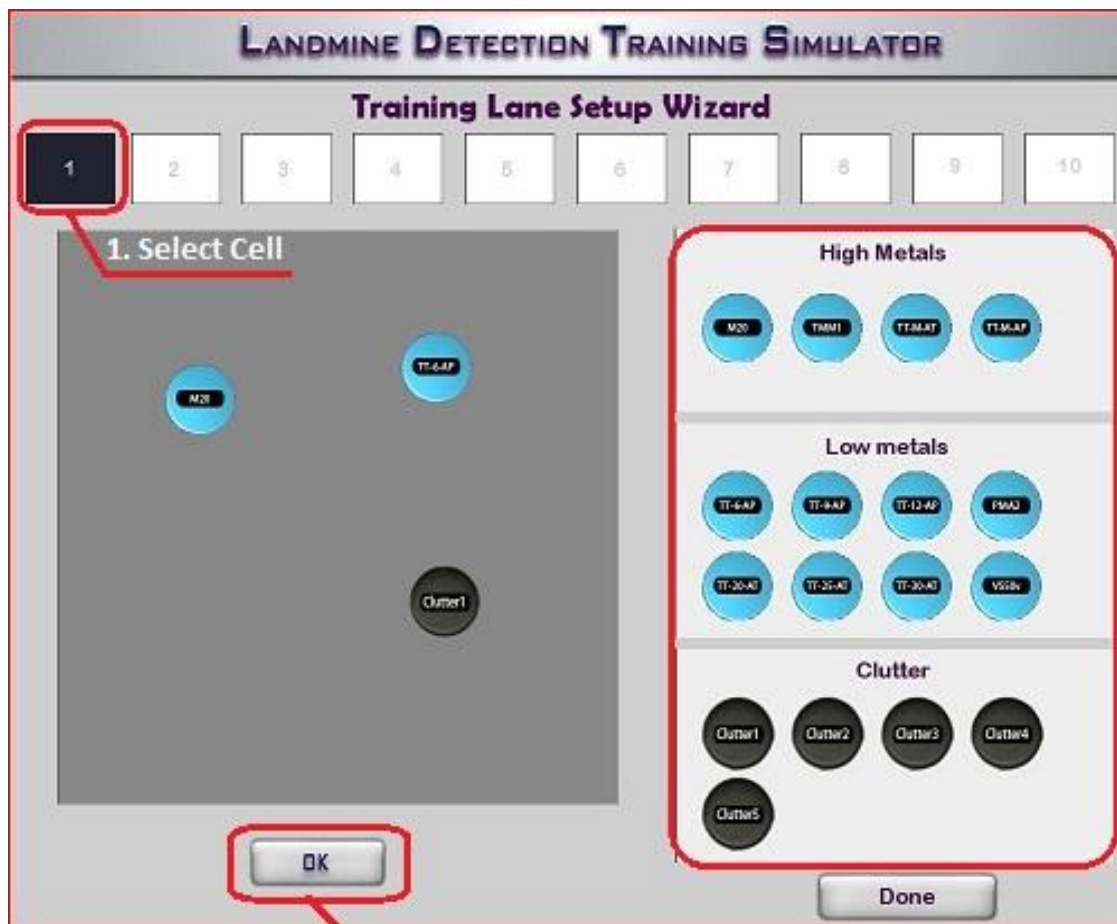


- Simulated detector features:
 - Similar controls
 - Similar size and weight distributions to provide same swing moment of inertia as the actual detector
 - Four IR LEDs were attached to the mine detector head to identify its position and orientation.





- Two Wiimotes were used to form a stereo system which provides 3D position of the mine detector
- The Wiimote stereo vision system is set at 45° relative to the vertical direction, 2 m from the ground, and the coverage is $1.6\text{m} \times 1.8\text{m}$



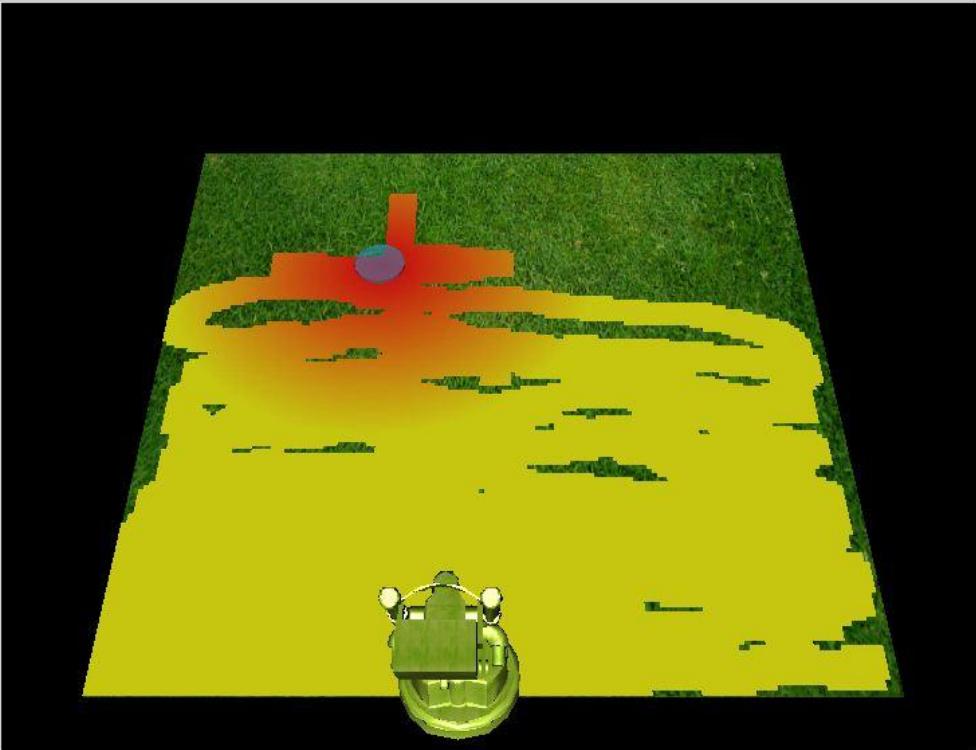
2. Drag and drop mines

3. Press OK to finalize configuration

LANDMINE DETECTION TRAINING SIMULATOR

STOP TRAINING COLOR SCHEME SHOW COVERAGE HIDE MINES/CLUTTER

Trainee # first last




A 3D perspective view of a landmine detector, a small green vehicle with a sensor, positioned on a yellow field. A red crosshair is visible on the field, indicating a detected mine. The field is surrounded by green grass.

Cell # 2

Detector Speed:
0.000 ft/sec

Detector Height:
2.400 in



A 3D perspective view of a landmine, a small green cylindrical object with a sensor, positioned on a yellow field.

Bit Failure

Next Cell

- Relatively inexpensive
- Fundamental program could have other algorithms that define performance parameters of any other handheld detector plug in – thus would be comparatively easy to evolve device into a simulator for any of the different types of handheld mine detectors the Army uses
- Enables training indoors in a space as small as 6 by 10 feet
- Can focus training on the tasks that need to be trained
- Provides visual history of performance for the Soldier
- Enables tailoring the lane difficulty to the Soldier's skill level
- Provides comparative performance over time

- The Army, academia, and industry all came together to produce a product that none of the agencies alone could have accomplished
- While yet unproven, there are reasons to believe the landmine simulator could improve efficiency of refresher training
- The concept can readily be adapted to any number of other handheld mine detectors
- The landmine simulator provides a new and innovative way to train handheld detection with the many advantages of simulation
- Though not being used now, it demonstrates what is possible in another area of simulation training